AL-TP-1992-0014

AD-A249 862

INTRODUCTION TO TRAINING DECISIONS MODELING TECHNOLOGIES: THE TRAINING DECISIONS SYSTEM

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April 1992

Final Technical Paper for Period January 1990 – April 1990

Approved for public release; distribution is unlimited.

AIR FORCE SYSTEMS COMMAND
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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE
April 1992

3. REPORT TYPE AND DATES COVERED
Final – January 1990 – April 1990

4. TITLE AND SUBTITLE
Introduction to Training Decisions Modeling Technologies: The Training Decisions System

5. FUNDING NUMBERS
PE – 62205F
PR – 1121, 1121
TA – 12, 13
WU – 01, 03

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Armstrong Laboratory
Human Resources Directorate
Technical Training Research Division
Brooks Air Force Base, TX 78235-5000

8. PERFORMING ORGANIZATION REPORT NUMBER
AL-TP-1992-0014

9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This paper is an introduction to the Training Decisions Modeling Technologies under development at the Armstrong Laboratory. These technologies are intended to support Air Force Training Managers by providing them with cost and resource information about the impact of their decisions on the AF training system. The Training Decisions System (TDS), which forms the baseline technologies for the research program, uses information about jobs performed by airmen, personnel assignment flows, course training content, and training resources to determine training capacities and the most cost-effective training options available. The TDS develops a model of a job specialty's Utilization and Training (U&T) pattern according to data collection results and simulates the flow of airmen through it. Based on this simulation, TDS tabulates the costs associated with training and evaluates the training capacity of the training system (i.e., the ability of the training system to provide training to a given number of airmen).

14. SUBJECT TERMS
Air Force training
Career path
Decision support system
Jobs
Modeling
Training

15. NUMBER OF PAGES
32

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PREFACE

This paper is an introduction to the basic methodologies and modeling concepts which underlie the Training Decisions System (TDS) and the Training Decisions Modeling Technologies (TDMT) currently under development at the Armstrong Laboratory. The reader is encouraged to seek out more specific information on these technologies by accessing the numerous publications and presentations cited in this paper and its appendices.

SUMMARY

Effective training planning and programming is crucial to the operation of an organization. Unfortunately, the environment in which training decisions are being made in the United States Air Force is characterized by a decentralized management system and a lack of readily available data upon which to base decisions. Training planners are consequently forced to make training decisions without reliable estimates of the cost and capacity implications of their decisions. In an era of fiscal constraint, it is imperative that training planners be provided with this information. The AF has undertaken the Training Decisions Modeling Technologies research program to address this problem. The Training Decisions System (TDS), which forms the baseline technologies for the research program, uses information about jobs performed by airmen, personnel assignment flows, course training content, and training resources to determine training capacities and the most cost-effective training options available. TDS develops a model of a specialty's Utilization and Training (U&T) Pattern according to data collection results and simulates the flow of airmen through it. Based on this simulation, TDS tabulates the costs associated with training and evaluates the training capacity of the training system. Specific technologies developed within TDS, such as Task Module construction and allocation curves, have greatly enhanced our training decisions modeling capabilities.

Introduction to Training Decisions Modeling Technologies: The Training Decisions System

Training planning and programming is a vital part of any training system, and an effective training system is paramount to the successful operation of an organization. Yet, policy makers and training managers are being asked to make decisions about training -- decisions which will affect the entire organization -- without the necessary information or tools they require. Policy makers and training managers operate in an extremely complex environment. They must often make decisions based on limited information and best guesses about what to train, where to train, and when in a worker's career to provide training. Moreover, these training planners are unaware of many of the potential impacts or consequences of their decisions.

This paper presents an overview of the Training Decisions Modeling Technologies currently under development by the United States Air Force to facilitate and enhance the quality of training planning decisions. We will present a sample training problem and examine the process by which the Training Decisions System (TDS) -- which forms the baseline technologies, methods, and models of this research program -- collects, processes, and provides outputs of relevant cost and capacity data in order to facilitate AF training planning decision making. Detailed information is available on this line of research in a number of separate publications. A list of publications and presentations associated with TDMT research program can be found in Appendices A and B, respectively.

The US Air Force Training System

Training in the AF is an essential and integral part of every airman's career. Training begins with basic military training and continues throughout the remainder of an airman's career. Each year, thousands of airmen are provided technical training in over 200 AF specialties (i.e., occupational categories). The AF training system includes formal courses for resident students conducted at Technical Training Centers (TTCs); continuing on-the-job training (OJT) performed at field units; and additional training accomplished in a number of other settings, including ATC Field Training Detachments (FTDs), Career Development Courses (CDCs), Major Command (MAJCOM) programs, mobile training teams, contractor-provided training, and inter-service programs and courses.

Technical training within the AF, including initial technical training and follow-on training, is an expensive undertaking. Current estimates place the annual technical training budget at approximately one billion dollars. AF training planners are tasked with the large responsibility of managing the AF training system and developing cost-effective training programs for each AF specialty. The size and complexity of the AF training system, however, creates considerable problems for AF training planners and constrains their ability to make decisions about the most effective and efficient way to allocate job training content across alternative training settings--what tasks should be trained in which settings (e.g., technical training centers, on-the-job training)--and at what points in an airman's career certain training content would be most beneficial. A decentralized training management system, limited training resources, and the lack of readily available information upon which to base cost comparisons are among the factors complicating the decision making process.

The bottom line is that training planners, such as the functional managers of Air Force specialties, must make training decisions without reliable estimates of their cost and capacity implications. Many of the costs associated with training simply elude AF training planners because of the dearth of available information on training content, training demand, the number of personnel moving through jobs and training, resources required for training, and the number of resources available to provide training. Some costs, like those associated with on-the-job training, are hidden costs which have traditionally been neglected. This is in part due to the absence of OJT cost accounting procedures and the fact that these costs are subsumed under the operational budget. Training capacity information is also scarce. The training system can only process a certain number of airmen given its resource constraints. Unfortunately, there is no systematic means by which these constraints can be evaluated. In an era of fiscal constraint, it is imperative that training decisions be made with full knowledge of the associated cost and capacity implications.

The United States Air Force has recognized the unwieldy problems which face those persons responsible for making AF training decisions and has undertaken a research program to address them. The present approach to these problems has been the development of a computer-based decision modeling technology known as the Training Decisions System (TDS). The baseline technologies developed under this research program integrate training requirements, as well as manpower and cost considerations, into a single comprehensive model. These technologies use information about jobs performed by airmen, personnel assignment flows, course training content, and training resources to determine training capacities and the most cost-effective training options available. The present version of the TDS consists of three basic subsystems and a fourth integrating subsystem: the Task Characteristic Subsystem, the Field Utilization Subsystem, the Resource Cost Subsystem, and the Integration and Optimization Subsystem.

Sample AF Problem

A meeting of senior level AF officers (colonels) was recently convened in order to review AF maintenance training.

This group of officers, known as the Maintenance Training Advisory Group (MATAG), identified a need to determine the impact of reduced TDY-to-school funding (training which occurs at a location away from an airman's workplace) on on-the-job training (OJT) and the AF mission. Budget cutbacks have not yet had an impact on TDY-to-school funding, but the group noted that it was only a matter of time before the cutbacks do have an effect.

The advisory group's main concern was to identify those AF specialties which were the best candidates for reduced TDY-to-school funding given the potential for cutbacks in this area. This sort of inquiry reinforces our earlier observation that training planners are inadequately prepared to make training planning decisions at the present time. For reasons previously noted, training planners are unable to determine the impact of reduced TDY-to-school funding on OJT costs, let alone the impact on costs associated with the entire training system. Moreover, training planners are unable to determine whether or not the training system can logistically support alternative training programs; i.e., operational units may not have the necessary labor and/or non-labor resources to support an increase in OJT if the training burden should shift away from formal courses.

The Training Decisions Modeling Technologies currently under development by the AF can aid training planners in making their decisions by providing them with macro-level cost and capacity information about the AF training system. In order to illustrate this point and demonstrate the capabilities of the current Training Decisions Modeling Technologies, we will examine how TDS can help inform training planning about a real world question -- i.e., what is the impact of reduced TDY-to-school funding on OJT -- for the Aircraft Environmental Systems (423X1) specialty.

Training Decisions System (TDS)

Decision Factors. Training planners for the Aircraft Environmental Systems job specialty must determine what the impact will be on their OJT requirements if the opportunity for formal training is reduced due to budget cutbacks. If we conceptualize such a problem, we can see that many outcomes are possible. For example, a reduction in TDY-to-school funding could adversely affect overall training costs for the 423X1 specialty by dramatically increasing OJT requirements and costs. On the other hand, OJT requirements and costs may be only slightly increased and therefore result in an overall savings.

The primary consideration here is cost, but other factors must be considered along with cost in order to make a fair assessment of the impact of reduced TDY-to-school funding. Training planners also require information about the effects of reduced funding on training capacities -- the number of airmen the training system can process. Alternative training programs are not viable if they cannot support a specialty's training requirements. Training proficiency is a third factor deserving of consideration. However, since TDS purposely models airmen such that they become fully proficient on the tasks being trained, training decision impacts on training and job performance are not modeled. Future research will be directed at modeling the impact of training decisions on these issues.

TDS Overview. In the above discussion, we determined that training planners require at least two fundamental types of information (assuming airmen must be trained to full proficiency) to make an informed decision about the impacts of reduced TDY-to-school funding. That is, they require information about the cost and capacity implications of their decisions. We will now examine the process by which training planners go about implementing TDS in order to obtain the necessary information about their job specialty.

TDS essentially operates by developing a dynamic model of an AF specialty's utilization and training (U&T) pattern -- i.e., the typical flow of airmen through the job and training states associated with a given specialty (Figure 1):

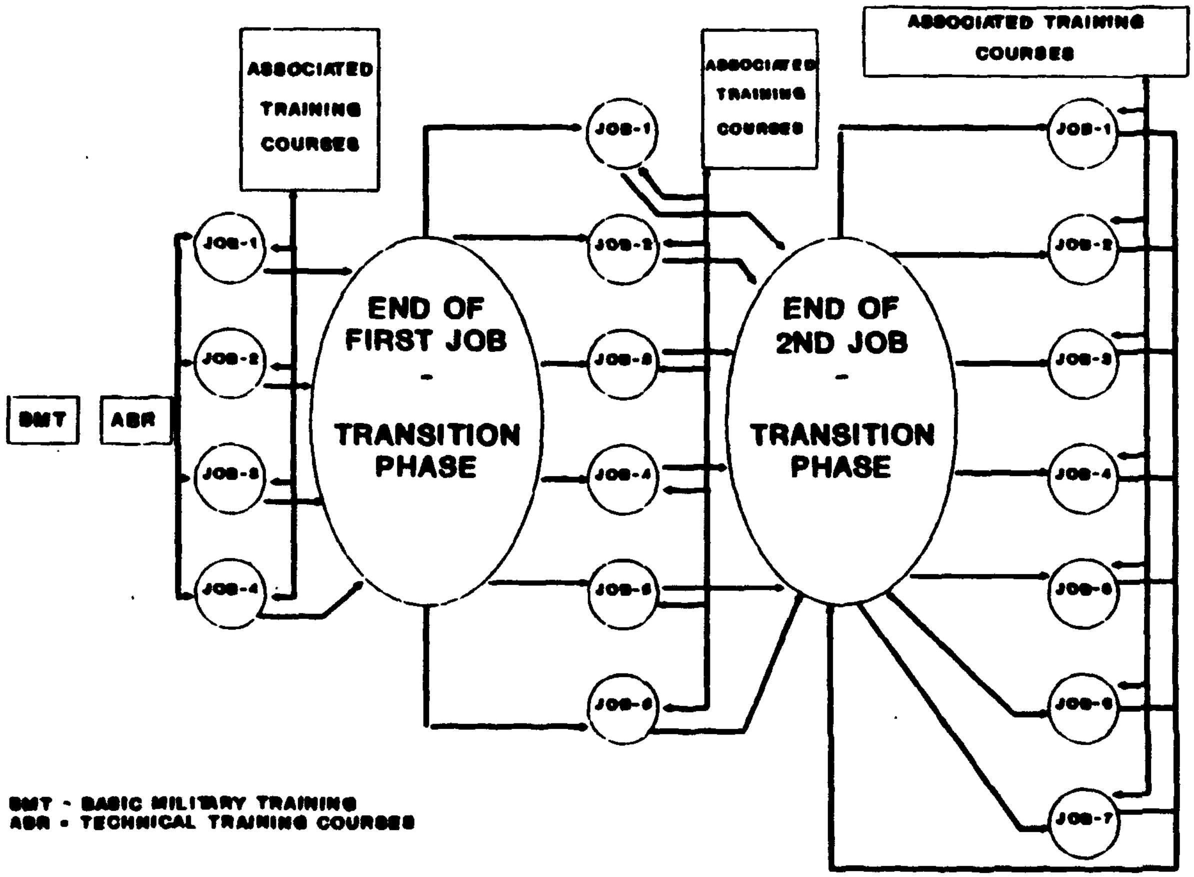

Figure 1. Generic Utilization and Training Pattern

Figure 1 represents the flow of airmen from their initial training (e.g. Basic Training) to their subsequent job assignments. During each job assignment or phase, airmen receive both formal course and on-the-job training. This training is mandated by either the particular job an airman performs or by an airman's time in service. Using this model as a baseline, TDS simulates the flow of airmen through the U&T pattern and determines the impacts of training decisions, such as reduced TDY-to-school funding, on the costs and capacities of the training system. Consequently, collecting the necessary data to describe and model a specialty's U&T pattern is the first step in a TDS analysis (see Mitchell, Vaughan, Yadrick, Collins, and Hernandez, 1988; Yadrick, Knight, Mitchell, Vaughan, and Perrin, 1988).

The objective of the data collection effort and its associated procedures is to develop an accurate picture of the AF training system as it pertains to a particular AF specialty. This is accomplished in several steps:

1. Jobs and training courses for a particular AF specialty must be identified.
2. Next, the jobs and training courses which are identified for the specialty must be described in terms of their task composition. The TDS uses Task Modules (TMs) -- i.e., groups of tasks sharing similar characteristics -- for this purpose.
3. Training course and job assignment flows must also be identified in order to build a U&T pattern for the specialty (figure 1, above). This pattern will be used as a baseline for simulating the impact of training decisions.
4. Resource and cost information is developed for each task module (TM) in a given training setting (i.e., technical training center, field training detachment, on-the-job training, correspondence, etc...). This allows TDS to describe each of the training courses within a U&T pattern in terms of cost and resource requirements.
5. Finally, information for describing and developing representative sites -- hypothetical AF units used to characterize several similar actual AF units -- must be collected for the specialty. These sites are used to calculate TDY and travel costs and show variations in the availability of resources for training purposes. Based on this information, the TDS model can determine the capacity limitations of the training system--i.e., the correspondence or disparity between resources available for training and resources required for training.

The information collected in the above steps is used to develop a model of the current U&T pattern for a particular AF specialty. TDS simulates the flow of a specified number of airmen through the U&T pattern based on the specific transition probabilities (to jobs and to training courses) identified for the pattern. Each simulated airman receives training in both formal (courses) and informal settings (OJT) based on the set of TMs associated with their specific jobs. Training costs are calculated for each airmen and aggregated for the entire specialty.

Utilization and Training (U&T) Patterns. U&T patterns are composed of two basic elements: jobs and training courses. The initial tasking of a TDS analyst is to identify the training course and job assignment flows which characterize a given specialty and describe each job and training course within the specialty in terms of its content (task composition). At present, there is no central data base containing all the necessary information about jobs and courses. This information must be collected through a combination of data collection techniques including surveys, interviews with subject matter experts (SMEs), and reviews of various records and data bases (references).

An analysis of the Aircraft Environmental Systems specialty reveals that it's U&T pattern is composed of essentially ten different jobs and their associated training courses (Figure 2). The jobs identified in this diagram do not necessarily correspond to those identified in other AF data bases. TDS classifies jobs according to their task composition; other AF data bases may have different classification schemes (Shartle, 1959). For a more complete account of job identification within TDS see Yadrick et al., 1988.

At this point in the TDS analysis, the U&T pattern, like the one developed for the 423X1 specialty, is merely a shell which must be filled in. Each job and training course within the initial framework requires further elaboration. Jobs must be described in terms of their tasks; that is, in terms the tasks which a person within that job is expected to perform. Training courses must also be described in terms of the tasks they train. As will be seen, the TDS uses the information collected about job and training course content to determine the extent to which each task is trained at the formal schools and/or on-the-job.

Job and Course Descriptions: Task Module Construction. TDS describes both job and training content in terms of groupings of tasks called task modules (TMs), rather than individual task statements. The use of task level data is widespread in the Air Force, but TMs were chosen for use in the TDS because they avoid a number of problems inherent in task level data (see Perrin, Knight, Mitchell, Vaughan, & Yadrick, 1988). TMs serve as the basic units of analysis in the TDS and each of its subsystems. They are used to describe job and training content and are the basis for determining costs and resource requirements.

Normal task analysis procedures often result in repetitive data because many tasks share common skills and knowledges. TMs avoid this problem by grouping together tasks with similar skills and knowledges. The resulting TMs increase the efficiency of the training analysis process and reduce the possibility of

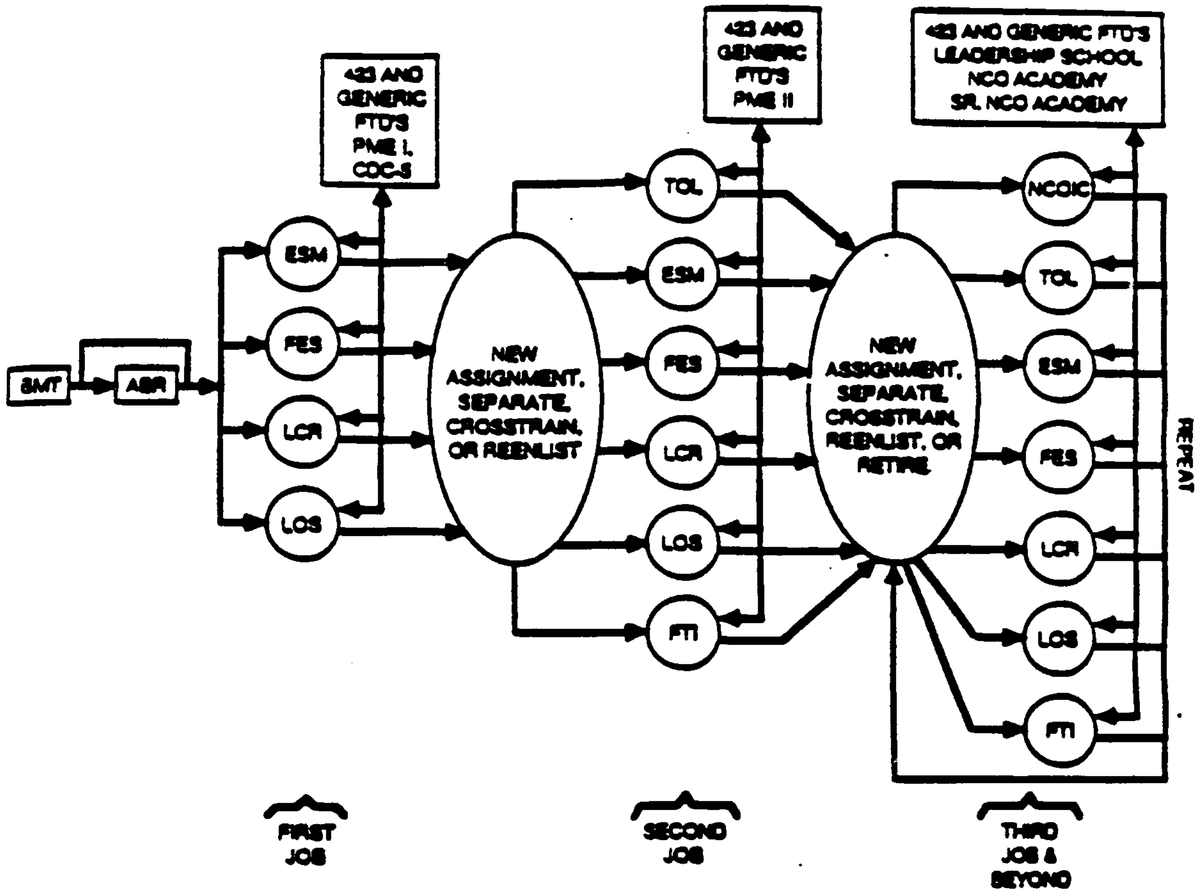

Figure 2. Sample U&T Pattern for AFS 423X1.

Figure 2. Sample U&T Pattern for AFS 423X1 (Mitchell & Yadrick, 1989)

overestimating training requirements. TMs are also more manageable than task level data. Since each AF specialty has between 300 to 2000 tasks associated with it, the use of task level data can be very taxing, not to mention time consuming and expensive. TMs organize tasks into coherent, manageable bundles. (see also Perrin & Bennett, 1989)

Procedures for TM construction are found in the Task Characteristic Subsystem of the TDS. These procedures were arrived at after an empirical evaluation of two separate approaches during the initial research and development phase of TDS (Perrin et al., 1988). The first to be evaluated was a judgmental approach. In this approach, subject matter experts (SMEs) were asked to group together those tasks within their specialty which they believed should be trained together. It was assumed that consensus judgements of several of SMEs about which tasks within their specialty should be trained together were the best criterion against which to judge TM construction. The judgmental approach, however, had some drawbacks. First, disparity existed between the TMs formed by separate SMEs. SMEs tended to form TMs according to their own experiences and perspectives. It was only after extended negotiations that a fair -- but not complete -- consensus was obtained. A second major drawback to this approach was the large amount of time it consumed.

The second approach to be evaluated involved multivariate statistical clustering (Perrin & Bennett, 1989). Multivariate techniques were used in an iterative manner with a variety of input data including the probability of task co-performance (derived from occupational survey data), common equipment usage, and skill-level information. It was found that the latter two variables added little, if any, refinement to those clusters formed on the basis of co-performance. The Comprehensive Occupational Data Analysis Program [CODAP] software system is currently the primary tool for advanced work on the hierarchical clustering of tasks.

Co-performance clustering represented a considerable time savings when compared to the judgmental approach and provided a fair approximation of SME judgements. The recommended approach for task module construction was a combination of statistical clustering and SME refinement (Perrin et al., 1988). Co-performance clusters were formed and subsequently refined by SMEs. SMEs provided a descriptive title for each TM, placed single unclustered tasks in the appropriate TMs, and ensured the overall quality of the TMs. Task analysis has revealed that TMs constructed under these procedures contained tasks with similar skills and knowledge requirements.

TMs are used to describe the content of each job and training course identified in the U&T pattern. Each job has a unique set of TMs associated with it. Similarly, each training course provides training on a unique set of TMs. (TDS describes training courses as though they are ideal courses -- the TMs identified for a particular course and actual training course content don't always coincide exactly.)

<u>Resource and Cost Information</u>. A major objective of TDS is to provide training planners with cost and resource information about their specialty. In order to do this, TDS estimates the quantity of 1) instructor hours, 2) student hours, and 3) non-labor resource hours devoted to training each TM within a given training setting. These data are collected by means of a questionnaire or, in the case of student hours, based on the simulated flow of airmen through the U&T pattern. Estimated instructor hours and non-labor resource hours are used to determine resource requirements for each TM. As will be seen later, TDS compares these resource requirements to resource availability to determine whether or not training capacities are exceeded. Readily available information about non-labor resources, such as the types and amounts of resources required to train a particular TM in a given training setting, is surprisingly scarce due to a decentralized, unstandardized training management system.

Labor costs are based on the hourly salaries of students and instructors and the estimated quantities of student and instructor hours for each TM. These costs are easily calculated for formal settings where information regarding training times is readily obtainable through surveys. Procedures for determining the labor costs in informal or OJT settings, however, are a bit more involved.

On-the-Job Training Requirements: Task Module Allocation Curves. Determining OJT requirements has historically been a difficult task. Every unit within the AF seems to conduct OJT in their own peculiar way. It is virtually impossible to ascertain the amount of time spent on OJT in general and, more precisely, on training specific tasks. Consequently, the labor costs associated with OJT have remained hidden. TDS overcomes this problem by means of allocation curves. These curves (figure 3) show the relationship between training time and proficiency for a given TM in different training settings.

In Figure 3, we see allocation curves for four different training settings: on-the-job training, technical training centers, field training detachments, and correspondence. These curves are derived from SME judgements of the current, ideal, and maximum training times for each TM. (see Perrin et al., 1988; Vaughan, Mitchell, Yadrick, Perrin, Knight, Eschenbrenner, Rueter, & Feldsott, 1989) The curves are, in most cases, negatively accelerating. This plateauing of the curves represents the maximum proficiency attainable for a particular TM in a given training setting. Combinations of training settings and training times can be used to reach full proficiency. In other words, proficiencies for a given TM are additive across training settings.

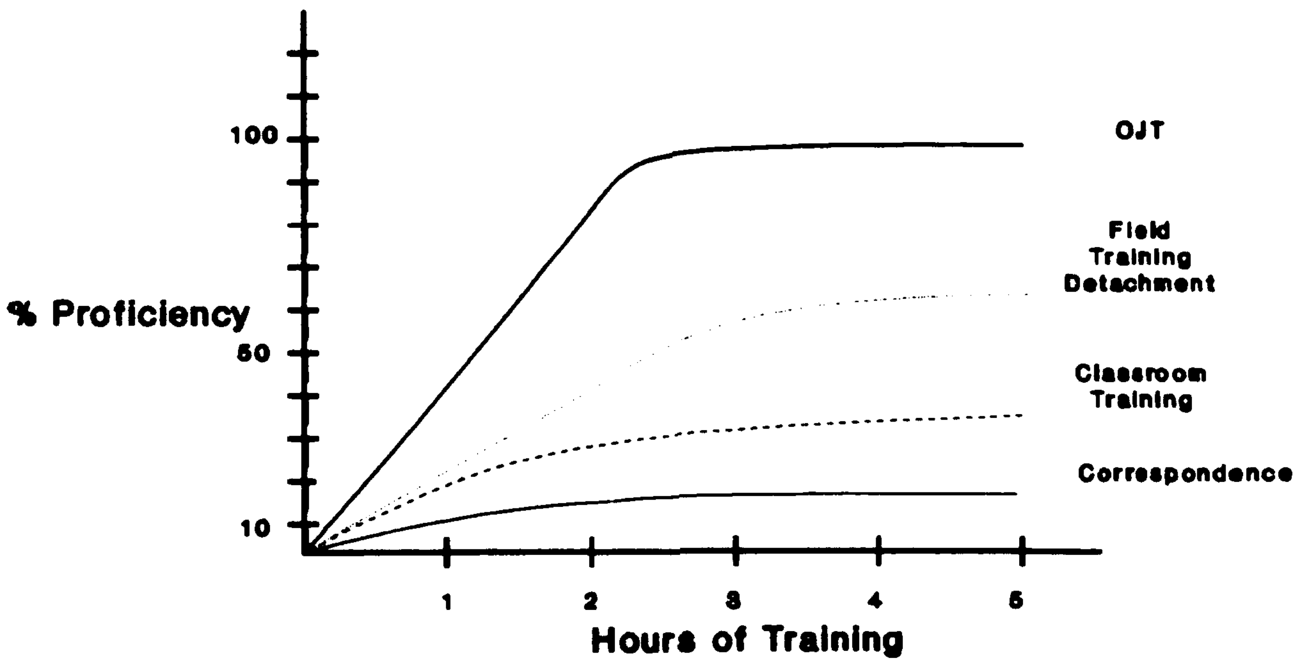

Figure 3. Sample Task Module Allocation Curve

TDS uses allocation curves to determine the number of training hours beyond those already expended in formal courses necessary to bring an airman up to full proficiency on a given TM. Using information about the amount of time devoted to a particular TM in formal courses, TDS can determine the amount of proficiency an airman has attained on that TM. Assuming all airmen must be trained to full proficiency, TDS can calculate the number of hours required in OJT to bring an airman to full proficiency. These figures are then translated into OJT labor costs.

For example, an airman receives training for a particular TM in two different formal training settings, a technical training center and a field training detachment, for 1 and 2 hrs, respectively. Using the allocation curve (figure 3) developed for this particular TM, we find that 1 hr of training at the technical training center results in a 20% proficiency and 2 hrs of training at an FTD results in a 40% proficiency. Thus, the airman is 60% proficient on this particular TM after attending the associated formal training courses. The remaining 40% proficiency (i.e., assuming 100% proficiency) is attributed to 1 hr of training in an OJT setting. OJT costs for the TM are calculated accordingly.

Representative Sites: Travel Costs and Training Capacities. We are slowly filling in our picture/description of the training system. Thus far, we have identified the training course and job assignment flows for an AF specialty (the Aircraft Environmental Systems specialty in particular), described the jobs and training courses within the specialty in terms of TMs, determined the types and quantities of resources required for training each TM in a given setting, and determined the labor and non-labor costs associated with training each TM in a given setting. We still need two more pieces of information before our picture is complete and we can begin dynamic simulations of the training systems. Both pieces of information, travel/TDY costs and training capacities, are based on the development of representative sites.

A representative site is a model of a hypothetical AF unit used to characterize several actual similar AF units (Rueter, Feldsott, and Vaughan, 1989; Rueter and Feldsott, 1989). Representative sites are based on mission, major command, resource availability, and job composition. Each actual AF unit within a specialty is associated with a representative site so that local variations in travel and TDY costs for a particular U&T pattern can be accounted for in the TDS model. The use of representative sites also reduces the number of comparisons needed to evaluate training capacities.

Each representative site has a certain training capacity based on: 1) the allocation of training time to specific TMs in a given setting; 2) resource requirements for training specific TMs in a given setting; 3) the flow of airmen through the site (or training volume); 4) the combinations of TMs which must be trained (i.e., job and course content) at the site; and 5) the resources available to support that training (Rueter and Feldsott, 1989). All of these inputs derive from previously formed data bases except the last one. Data regarding resource availability at the representative sites must be collected to round out our picture. Based on all of these inputs, TDS estimates training capacities for a given U&T pattern and identifies any resource limitations which might exist in the training system. Thus, while it might be cost effective to implement a certain training program, the training system may not have the required training capacities.

Training System Simulations. TDS analyses are dependent upon thorough, accurate data collection procedures. The data bases formed by these procedures provide TDS with a complete picture of the AFS being examined. Based on this picture, TDS simulates the flow of airmen through the U&T pattern and tallies the costs associated with their training. Each simulated airman or "entity" passing through the U&T pattern develops a unique record which shows their own training history in terms of TMs. These histories allow the TDS model to determine the training requirements, formal and OJT, for each airman at each phase of their career and the costs incurred because of such training. Training costs vary according to which TMs are trained and in which settings.

Histories differ from entity to entity because of the probability-based nature of the TDS model. At each phase in the U&T pattern, the likelihood of any airman receiving a particular training course or particular job is based on predetermined probabilities. Thus, for example, after completing Basic Military Training, an airman in the Aircraft Environmental Systems specialty will either attend the basic resident course for that specialty or be assigned directly to a job (see figure 2). The TDS analyst determines the probability of either occurrence based on an analysis of the actual U&T pattern. A data base of transition probabilities is developed for the entire U&T pattern according to the TDS analyst's preliminary evaluation of the training course and job assignment flows.

The simulation is perhaps best understood by following a single entity through the model of the 423X1 U&T pattern (Figure 2), although the actual TDS simulates the flow of hundreds or thousands of entities through the model in order to achieve a "steady state." In this example, our simulated airman (entity) enters Basic Military Training with a specified number of other airmen. This initial training is mandatory. Following BMT, our simulated airman will either attend the basic resident course or bypass it. Due to random selection, our simulated airman is sent to the basic resident course, and his training history is updated to show the training he received in that course.

Prior to his first assignment or job phase, the TDS temporarily groups our airman together with all of the other simulated airmen -- both those who have attended the resident course and those who have bypassed it. The airmen are then distributed from this common collect to the their first assignment jobs according to predetermined probabilities and regardless of the entity's previous background. Our simulated airman is assigned to the Environmental Systems Maintenance job -- the largest first assignment job -- by chance. While in that job, our airman has the opportunity to receive additional training courses -- once again based on probability. Some courses are related to the job itself and others are related to the airman's time in service.

Training which is required by the airman's job and not received from formal courses must be trained in OJT. Training histories are used to determine OJT requirements for each airman. That is, the TM content of the job is compared to the TMs in the airman's training history and proficiency deficits are identified. These deficits are assumed to be trained in OJT.

Following the first assignment, TDS gathers all of the simulated airmen into a common "collect" before distributing them to their second jobs. The collect includes airmen who have finished their first assignment in the 423X1 specialty and airmen who have entered from other specialties. Once again, the simulated airmen are distributed according to predetermined probabilities, regardless of their prior histories. The airmen enter their new jobs, receive the associated training, and are collected into a common pool before being assigned to their next jobs. This pattern is repeated through out the U&T pattern. Costs are tabulated according to the training each entity receives.

<u>Alternative Simulations: Training Decision Impacts</u>. The cost and capacity implications of training decisions can be evaluated by modifying the model of the current U&T pattern. Changes are made to the appropriate data bases within the model in order to simulate the particular training decision or policy being examined. At the beginning of the paper, we wanted to examine the impact of a reduction in TDY-to-school funding on the Aircraft Environmental Systems specialty. After developing a model of the current U&T pattern for that specialty, simulating the impact of a reduction in TDY-to-school funding becomes a matter of changing data bases. The results in Table 1 represent a reduction in TDY-to-school funding for the 423X1 specialty as it was actually modeled in TDS. This reduction in funding was modeled by reducing the probability (i.e., in the appropriate data base) that airmen would receive training in courses which required TDY travel.

The cost implications for OJT, as well as for the training system in general, can be seen in Table 1. Reducing the probability that an airman will attend off-site training increases the training burden and cost of OJT while reducing the costs associated with formal training courses. An overall savings is realized by reducing the probability of TDY-to-school. The values shown in table 1 do not represent actual dollars, rather they represent relative dollar amounts.

Other training decisions can also be modeled by restructuring the U&T pattern and/or changing the appropriate data bases. It is up to the TDS user to determine exactly how a particular training decision will be represented. The user, for example, may choose to represent a reduction in TDY-to-school funding by eliminating training courses from the model rather than reducing the probability of attendance at the courses.

	TRAINEE/ TRAINER COSTS	TDY COSTS	OJT COSTS	TOTAL AFS TRNG COSTS PER YEAR
CURRENT U&T	1,081,000	1,010,000	556,000	2,647,000
REDUCED TRAVEL	952,000	864,000	562,000	2,378,000
DIFFERENCE	-129,000	-146,000	+6,000	-269,000
PERCENT DIFFERENCE	-11.93%	-14.46%	+1.08	-10.16%

NOTE. MODELED AS 25% REDUCTION IN THE PROBABILITY OF ATTENDING FTD, PME, OR ADVANCED COURSE

Table 1. TDS Analysis of the impact of reduced TDY-to-school funding on OJT requirements within AFS 423X1

Supplemental Example. Examining the impact of reduced TDY-to-school funding on the Aircraft Environmental Systems specialty represents one specific application or use of the TDS. Such an analysis was brought about by budgetary concerns, i.e., the lack of funding. The Training Decisions System can be used to analyze the cost and capacity implications of a wide variety of issues and not simply those driven by budgetary concerns. For example, a training manager may use TDS to resolve a training capacity problem resulting from limited resources in one or more training settings; determine the impact of a personnel policy which allows maintenance specialists to move between large and small aircraft; or, examine the implications of shorter terms of enlistment (i.e., which will reduce the average experience level in a given specialty).

Following is an example of a training-related decision which can be modeled in TDS. In this example, training managers wish to examine the cost and resource capacity implications of removing the initial technical course for the Aircraft Environmental Systems specialty. Such a move would obviously reduce the cost incurred by Air Training Command (ATC) who provides the initial technical course, but the burden for training those tasks taught in the initial technical course would shift to the operational units. (ATC could arrange to train these tasks at dispersed locations, such as FTD, and thus avoid shifting the training burden to operational units. For this example, however, let us assume that ATC has not planned for such provisions.)

The TDS analyst would have to interpret the problem described above in terms of the TDS model for the Aircraft Environmental System specialty (Figure 2) and decide which data bases to change. The simplest way to simulate the elimination of the initial technical school course is to remove that course (and its training content) from the U&T pattern. The TDS model would then simulate the flow of personnel from Basic Military Training (BMT) straight into one of the jobs available in during a specialist's first assignment. Distribution of airmen to these jobs would be based on prior probabilities. The results of this analysis are shown in Table 2.

	CURRENT	NO ENTRY-LEVEL COURSE	DIFFERENCE	
ENTRY LEVEL COURSE	$941,517	$0	$-941,517	$663,289
OJT COST	530,189	808,417	278,228	
OJT HOURS	55,662 HRS	85,038 HRS	29,416 HRS	
OJT CAPACITY	NOT EXCEEDED	EXCEEDED		

Table 2. TDS analysis on the impact of eliminating the initial technical school course for AFS 423X1

Eliminating the initial technical school course for the Aircraft Environmental Systems specialty appears to save dollars for the overall training system. This would imply that it is more cost-effective to train the tasks covered by the technical school course on-the-job rather than at the technical school. However, the analysis also shows that the operational units do not have adequate resources to support the training associated with these tasks. The resource requirements exceed their capacity. Consequently, resource limitations must be resolved prior before elimination of the initial technical school course is feasible. The alternative is to eliminate the technical school course and accept decrease in proficiency levels and the associated consequences.

Summary

TDS develops cost and capacity information for a specialty by simulating the flow of airmen through the training course and job assignment flows (U&T pattern) which characterize it. The TDS user can simulate a number of different training decisions by manipulating the data bases and structure of a specialty's U&T pattern. Developing a model of the U&T pattern itself requires a substantial data collection effort: jobs and training courses must be identified and described in terms of their task content; training course and job assignment flows must be identified; and, cost and resource information must be collected and analyzed. In the end, a thorough data collection effort provides the user with a versatile and robust model of a specialty's training program.

The purpose of this paper was to give an overview of the emerging Training Decisions Modeling Technologies. Training planners often make training decisions without knowing the cost and capacity implications of their decisions. The Training Decision Modeling Technologies under development by the US Air Force offer a potential solution to this problem. The Training Decisions System, which forms the baseline technologies in the TDMT research program, provides training planners with tools and methodologies for examining training decisions.

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APPENDIX A - TRAINING DECISIONS MODELING TECHNOLOGIES: PUBLICATIONS[1]

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(1) Lamb, T.A.. "Overview of the Training Decisions System: Results and Products".

(2) Bennett, W.R. and Perrin, B.M. "The Task Characteristics Subsystem: Allocating Task Modules to Training Settings."

(3) Mitchell, J.L. and Yadrick, R.M. "The Field Utilization SubsystemL Job and Training Pattern Simulations."

(4) Rueter, F.H. and Feldsott, S.L. "The Resource/Cost Subsystem Estimating Training Capacities and Costs."

(5) Vaughan, D.S. and Eschenbrenner, A.J. "The Integration/Optimization Subsytem: An Integrated Modeling Approach."